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ABSTRACT

The purpose of this study was to investigate Korean high school students' perceptions about their science classrooms, focusing especially on the notions of constructivism. This study is one of the few, which has used the Constructivist Learning Environment Survey (CLES) in an Asian country. The study involved 439 high school students from 3 different streams, 145 from the humanity stream, 195 from the science-oriented stream, and 99 from the science-independent stream. The validity and reliability of the CLES were confirmed when used with Korean students. Associations between classroom environments and student attitudes were found. When the perceptions of students from the three streams were compared, it was found that students from the science-independent stream perceived their classroom environments more favorably than did students in the other two streams. Interviews with students revealed that students interpreted items in the Critical Voice and Shared Control scales of the CLES in ways that were not intended by the researcher. (Contains 24 references.) (ASK)

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The Constructivist Learning Environment of Science Classrooms in Korea

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The purpose of this study was to investigate Korean high school students' perceptions about their science classrooms, focusing especially on the notions of constructivism. This study is one of the few, which has used the Constructivist Learning Environment Survey (CLES) in an Asian country. The study involved 439 high school students from three different streams, 145 from the humanity stream, 195 from the science-oriented stream and 99 from the science-independent stream. The validity and reliability of the CLES were confirmed when used with Korean students. Associations between classroom environments and student attitudes were found. When the perceptions of students from the three streams were compared, it was found that students from the science-independent stream perceived their classroom environments more favourably than did students in the other two streams. Interviews with students revealed that students interpreted items in the Critical Voice and Shared Control scales of the CLES in ways that were not intended by the researcher.

Background

Constructivism has made a strong impact, internationally, on the educational field for over twenty years. In particular, science educators have been concerned with teaching strategies based on the notions of constructivism in an attempt to enhance students' conceptual understanding in science subjects. In many cases, these notions have been utilised as basic frameworks to reform traditional educational practices.

Educators in Korea also have been concerned with these constructivist notions in their quest to improve Korean education, which has been maintained by an examination-driven curriculum. Although the constructivist approaches have been consistently emphasised in science curriculum since 1982, actual practices in classrooms in Korea have been dominated by teacher-centred, lecture-type instruction. In order to improve this situation, a new science subject entitled 'KongTongKwaHak' (meaning integrated or general science) was developed in the sixth curriculum reform in 1996. This subject is composed of eight interdisciplinary themes, which were recommended to be taught with student-centred activities and negotiation. But other science subjects such as chemistry, physics, biology and earth science have remained academically content-oriented. As part of a large study that investigated Korean science classroom environments from several perspectives, this paper describes the aspect explored from a constructivist point of view.

Study of Learning Environments

The cornerstones of learning environment research can be found in the theoretical and conceptual foundations contributed by Lewin (1935) and Murray (1938). Lewin assumed that the environment and its interaction with the person mainly determined human behaviour. This notion was extended by Murray with his needs-press model. According to Murray, personal needs, or 'motivational personality characteristics', represent the tendency for individuals to move in the direction of goals, and environmental press is the external situational counterpart that either supports or frustrates the expression of those needs. This model, developed within the field of psychology, was extended to teaching-learning situations (Anderson &

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Walberg, 1974; Moos, 1974; Rentoul & Fraser, 1979), with the view of the class as a social system proposed by Getzels and Thelen (1960).

Stern, Stein, and Bloom (1956) elaborated on Murray's notion of 'beta press' to distinguish between 'private beta press' (the distinctive view of the environment held by an individual) and 'consensual beta press' (the shared view that members of a group hold about the environment). Private and consensual beta press could differ from each other, and both could differ from the detached view of alpha press of a trained participant observer. In classroom environment research, this useful distinction can be used when distinguishing between two units of analysis, namely, the individual student and the class. With this previous background, psychosocial characteristics of learning environments have been conceptualised, measured and investigated using perceptions of students since the late 1960's (Fraser & Walberg, 1981). The field of learning environments has become established, as shown in various publications (Walberg, 1981; Moos, 1979; Fraser, 1981, 1998; Moos, 1991; Moos & Trickett, 1974) and this trend has been extended up to now, specifically in science education (Fraser, 1998).

Research Objectives

This study was launched with the following objectives:

1. to validate an adapted version of the Constructivist Learning Environment Survey for use in Korean high school students;
2. to describe Korean high school science classroom environments from a constructivist perspective;
3. to investigate the associations between students' perceptions of the learning environment and their with attitudes towards science; and
4. to investigate differences in students' perceptions of the learning environments in three different streams, namely, the humanity, science-oriented, science-independent streams.

Past Studies with the CLES

During the development stage of the Constructivist Learning Environment Survey (CLES), classroom-based collaborative studies and larger-scale study were done in USA and Australia (Dryden & Fraser, 1998; Taylor, Fisher & Fraser, 1997). Each of these studies contributed to confirm the statistical validity of the CLES. The CLES has been also used to explore the effect of special programs designed to improve the students' learning, attitude and their learning environment (Taylor, Dawson & Fraser, 1995). The CLES has been used also in several studies involving non-Western countries (Aldridge, Taylor, Fraser & Chen, 2000; Idiris & Fraser, 1997; Soeharto, 1998).

Kim, Fisher and Fraser (1999) conducted a study using the CLES with Korean students in high school. They investigated the effect of a new curricula, mainly characterised by constructivist notions, and found that the science classrooms using this new curriculum were perceived more favourably by students than those taught by a traditional, academically-oriented curriculum.

The study described in this paper focused on the differences and similarities between three different streams in terms of students' perceptions of the classroom learning environments.

Methods

Three methodologies were employed to obtain an understanding of students' perceptions of classroom learning environment: survey, interview, and observation. Firstly, student perceptions about the degree of constructivist approaches in present science classes were investigated with the student perceived form of the CLES.

To gain a better understanding of the typical science classroom learning environment in Korea, in-depth interviews and classroom observations were used to complement the data collected using the questionnaire. These two methods (interview and observation) were used to refine the questionnaire and to seek explanations for patterns identified through statistical analysis of quantitative data. Reactions solicited from students during interviews about the readability and comprehensibility of individual items were used to elaborate and polish the questionnaire.

Survey

Initially, the CLES was based largely on a psychosocial view of constructivist reform that focused on students as co-constructors of knowledge. Although the original version of the CLES was used within Australian high schools and in other countries and found to be reliable, the theoretical framework supporting the survey was found to be limited. Adding the notions of radical constructivism and critical theory, the CLES was elaborated and revised. This new version has been found useful with a wide range of samples and was further modified to enhance the reliability. The version used in this study has five scales, containing five items in each scale, namely, Personal Relevance, Uncertainty, Shared Control, Critical Voice, and Student Negotiation.

In this study, the English version of the CLES was translated into Korean, using a method involving translation and back-translation. The first author translated the questionnaire into Korean version which was then back-translated into English by, a person not involved in the original translation. By comparing the original English questionnaire with the back-translated version, it was possible to ensure that both versions conveyed the same meaning as in the original version. Once this was established, the Korean version was pilot tested using a small sample of students to ensure its comprehensibility and readability.

Interview

During the pilot phase, interviews were carried out with students to enhance the useability of the translated questionnaire. During the main study, semi-structured interviews were conducted to complement the survey results. Interview questions were based on the questionnaire and slightly rephrased to make it easy for students to respond. The researchers utilised two mode of interviews, face-to face and e-mailing. The e-mail mode of interview were used during follow-ups and required a more extensive time line than the face-to-face mode. E-mail mode of interview was conducted as an alternative to face-to face interviews in cases where teachers did not allow the researcher face-to-face contact with their students.

In face-to-face mode, interviewer could gain facial expression such as feeling from interviewee, which make it easier to understand their talking. On the other hand, in e-mail mode, interviewer could not get any emotional cue from body

language, however, interviewee could take more time to elaborate their answers. (giving logic to their reply)

Observation

There are two main approaches for observations, either unstructured or structured. Within the structured approach, pre-planned schedules and coding systems are systematically used and sometimes the information is analysed in quantitative manner. In this case, the aspects which will be observed are planned clearly before the researcher approaches the setting. In contrast, the unstructured approach applies a logic that accepts emerging data during the observation and analysis process and aims to gather information. An unstructured approach is often used by ethnographers and referred to as 'participant observation'.

In this study, observation was used as a means of ethnographic inquiry whereby the natural setting was the classroom. In this sense, observations were used to examine aspects which might have been missed using survey and interview methods. During observations, data were collected in the format of field notes and photographs.

Sample

The sample consisted of grade 10 and 11 students (aged of 16-17 years) from three streams, namely, humanity, science-oriented and science-independent streams. In the humanity stream, 145 grade 11 students were involved from 4 classes in 2 schools. In the science-oriented stream, 195 grade 11 students were involved from 4 classes in 2 schools. In the science-independent stream, 99 grade 10 students participated from 5 classes in the same school. The humanity stream students are not supposed to select science in higher education and are provided with relatively general content in all science subjects. Science-oriented stream students, on the other hand, are supposed to select science in higher education and are provided with more advanced content in each area. Science-independent stream, students are provided with more advanced content within a shorter time than students in the other two streams. For each stream, a small number of representative students, who showed specific response patterns in the questionnaire survey, were interviewed and some characteristic classes were observed for deeper analysis. As a criterion for selecting students, willingness to participate in the study and patterns in their answers to the questionnaires were considered.

Analysis of Questionnaire Data

Validation of the CLES with Korean students

To confirm the *a priori* conceptual structure of the CLES when used in Korea, a factor analysis was conducted. A principal component analysis with varimax rotation was used to generate orthogonal factors. Because the instrument was originally designed with five scales, a five-factor solution was attempted. These five factors represented the scales of Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation. Table 1 shows the factor loadings obtained for the sample of 439 students in 13 classes in three streams from five schools. The factor loadings in this table are all greater than or equal to the conventionally-accepted value of 0.40. So, the results depicted in Table 1 support the notion that the 25-item

translated version of CLES assesses five different aspects of constructivism within the classroom environment. The 25-item version was modified from the original 30-item version, by omitting negative items, in an attempt to minimise conceptual complexity.

Table 1. Factor Loading for Items in the CLES

	Factor Loading				
Item No.	Personal Relevance	Uncertainty	Critical Voice	Shared Control	Student Negotiation
1	.64				
2	.64				
3	.63				
4	.75				
5	.76				
6		.70			
7		.75			
8		.62			
9		.74			
10		.68			
11			.71		
12			.71		
13			.80		
14			.73		
15			.56		
16				.77	
17				.78	
18				.84	
19				.76	
20				.73	
21					.65
22					.81
23					.78
24					.76
25					.74
% variance	10.72	11.06	10.84	13.40	12.62
Eigenvalue	2.68	2.77	2.71	3.35	3.16

Loadings smaller than 0.4 omitted. The sample consisted of 439 students in 13 classes.

Table 2 reports further validation information for the CLES based on its use in Korea. The Cronbach alpha reliability coefficient was used as an index of scale internal consistency, while the mean correlation of a scale with the other four scales was used as a convenient index of scale discriminant validity. Alpha reliability values for different scales with the individual student as the unit of analysis ranged from .78 to .87, and from .90 to .94 using class as the unit of analysis. This suggests that all scales of the Korean version of the CLES possess satisfactory internal consistency.

Another feature considered important in a classroom environment instrument is the discriminant validity of each scale of the instrument, that is, the extent to which the scale measures a dimension different from that measured by any other scale. In

this study, the mean correlation of one scale with the other four scales ranged from .32 to .36 for the individual as the unit of analysis and from .22 to.60 for the class as the unit of analysis. These values can be regarded as small enough to confirm the discriminant validity of the CLES, indicating that each scale measures distinct, although somewhat overlapping, aspects of the classroom environment.

Another desirable characteristic of the perceived form of any instrument like the CLES is that it is capable of differentiating between the perceptions of students in different classrooms. That is, students within the same class should perceive it relatively similarly, while mean within-class perceptions should vary from class to class. This characteristic was explored for each scale of the CLES using a one-way ANOVA, with class membership as the main effect. It was found that each CLES scale differentiated significantly ($p<.01$) between classes and that the eta^2 statistic, representing the proportion of variance explained by class membership, ranged from 0.03 to 0.08. These figures are relatively low and suggest that the learning environments of the different science classes in this sample are relatively similar to each other.

Table 2. Internal Consistency Reliability (Cronbach Alpha Coefficient), Discriminant Validity (mean correlation with other scales) and Ability to Differentiate between Classrooms (ANOVA results) for Two Units of Analysis for CLES Scales

Scale	Alpha Reliability		Discriminate Validity		ANOVA Eta^2
	Ind	Class	Ind	Class	
Personal Relevance	.78	.94	.35	.59	.07**
Uncertainty	.79	.92	.36	.34	.08**
Critical Voice	.80	.90	.34	.45	.04**
Shared Control	.87	.91	.32	.22	.03*
Student Negotiation	.84	.91	.33	.60	.06**

*$p<.05$
**$p<.01$

The similarity between different classrooms in Korea could be explained by the fact that science teachers are mostly dependent on textbooks which have similar content and structure across the streams, through rigorous screening procedures used by the Evaluation Committee of the Ministry of Education as described by Han (1995). Actually, the curriculum (especially the science curriculum) is different in each stream, but this difference might not be clearly displayed in science classrooms by each stream's science teachers. This might be one of the reasons for the existence of similar learning environments across science classes in Korea. Even though each stream has its own curriculum differently defined in science subjects, it is possible that the difference is not clearly displayed in the teaching. That is, only different contents are clearly perceived by students, not teaching strategies.

Science classroom environment investigation with the CLES

In this section, the learning environment of science theory classes is described in terms of the CLES. Table 3 shows the average item mean (obtained by dividing the

scale means by the item number of scale for each scale in the CLES). Figure 1 provides a graphic representation of the mean scores for each scale.

Table 3. Average item mean and standard deviation for CLES Scales for Two Units of Analysis

Scale	No of Items	Unit of Analysis	Average Item Mean	Standard Deviation
Personal Relevance	5	Ind	2.96	.21
		Class	2.93	.21
Uncertainty	5	Ind	3.15	.37
		Class	3.11	.35
Critical Voice	5	Ind	3.01	.31
		Class	3.04	.31
Shared Control	5	Ind	2.46	.11
		Class	2.47	.10
Student Negotiation	5	Ind	3.41	.21
		Class	3.41	.24

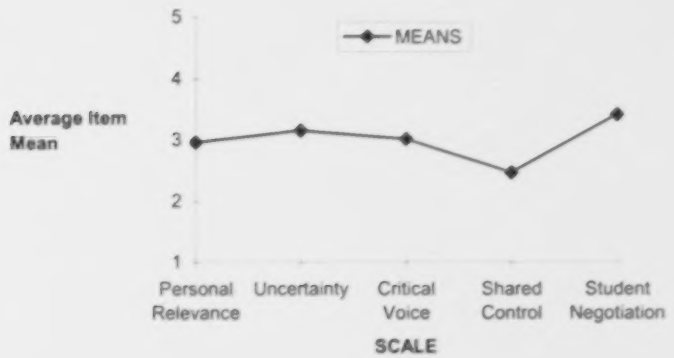

Figure 1. Korean high school students' perception on the Constructivist Learning Environment Survey

Overall, students perceived that their science classes 'sometimes' reflect constructivist aspects as the mean range was 2.5-3.5 (point 3 means 'sometimes'). The mean scores in personal relevance, uncertainty and critical voice scale were near to 3 which implies that aspects described in these three scales occur 'sometimes' in their classrooms. In case of student negotiation scale, students perceived that their science lessons 'more' than sometimes, but 'less' than often reflect aspects related to student negotiation, and they perceived that shared control occurs less than any other scale. This result from survey was further investigated using two other modes of inquiry, namely, interview and observation. Differences in learning environment perceptions in the three streams were also considered, as described in the next section.

Stream differences investigated with the CLES

To investigate the differences among the three streams, a one-way ANOVA was conducted. Firstly, the F value was used to identify the significant differences between streams. After that, the *t*-values were used to identify the significant difference between two streams in each pair (stream 1 and 2, stream 2 and 3, stream 1 and 3).

Table 4 shows that the students from the three streams have significantly different perceptions for all scales in the CLES. And each pair of streams has a statistically significant difference for most scales. Differences are especially distinctive between science-independent stream and humanity stream.

Table 4. ANOVA results for stream differences, with post-hoc t-tests for CLES

Scale	*F*	Significant *t* Values		
		Streams 1&2	Streams 2 & 3	Streams 3 & 1
Personal Relevance	20.39**	-5.28**	-2.95*	-7.75**
Uncertainty	12.74**	-4.02**		-6.08**
Critical Voice	10.03**		-3.73**	-5.60**
Shared Control	13.79**		-5.43**	-5.17**
Student Negotiation	41.98**	-3.92**	-8.01**	-11.69**

*$p<.05$
**$p<.01$
'Stream 1: humanity, Stream 2: science-oriented, Stream 3: science-independent

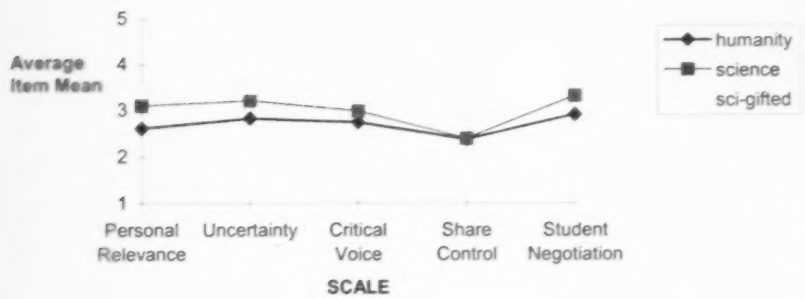

Figure 2. The difference between three stream students' perceptions on the Constructivist Learning Environment Survey

Generally, science-independent stream students perceived their classrooms more favourably than did any other stream for all CLES scales as shown Figure 2. In particular, the perceptions of science-independent stream students were significantly different from those of humanity stream students. Science-oriented stream students showed more favourable perceptions on three scales than did humanity stream students. The difference was less than in the case-involving science-independent stream, in terms of effect size. Critical Voice and Shared Control were perceived

similarly in humanity stream and science-oriented stream, but science-independent stream students perceived quite differently from each of two streams. It is noteworthy that especially, critical voice scale and shared control scale were perceived significantly differently by science-independent stream students. These results may imply that their perceptions are related to their attitude to science. This association between environmental perception and attitude to science is more clearly described in the next section.

Association with attitudinal outcome

In order to explore the aspects of constructivism related to attitude to science, two types of correlation analyses, namely simple correlation and multiple regression, were undertaken using the data provided by the CLES and TOSRA.

Table 5. Simple and multiple correlation analyses for associations between student attitudes and CLES for two units of analysis

Attitude Scale	Unit of analysis	Attitude-environment Association										
		Personal Relevance		Uncertainty		Critical Voice		Shared Control		Student Negotiation		Multiple Correlation
		r	*β*	*r*	*β*	*r*	*β*	*r*	*β*	*r*	*β*	*R*
Implications of science	Ind	.26**	.18***	.33**	.23***	.19**	.06	.10	-.05	.23	.12**	.37***
	Class	.78**	.22	.85**	.97	.19	.43	-.06	-.08	.59	-.51	.89
Normality of scientists	Ind	.23**	.12**	.23*	.12**	.19**	.08	.22**	.14**	.11**	-.03	.31***
	Class	.07	.43	-.25	.36	.12	.60	.59	.55	-.26	-1.39	.83
Attitude to scientific inquiry	Ind	.27**	.18***	.21**	.05	.19**	.06	.20**	.08	.21**	.10*	.32***
	Class	.59	.34	.61	.73	.15	.49	-.06	-.14	.38	-.68	.68
Personal interest in science	Ind	.41***	.29**	.30**	.08	.23**	.03	.27**	.12**	.29**	.13**	.47***
	Class	.48	1.00	.31	.33	.06	.39	.22	.08	.04	-1.27	.75

** $p<0.01$
*** $p<0.001$

As implied in the previous section, the association between students' perceptions on their environment and attitude to science is reflected in Table 5. Table 5 indicates personal interests in science are most strongly associated with CLES scales.

Calculations based on data collected using both the CLES and TOSRA indicated that there were associations between students' perceptions of the learning environment and their attitude to science, specifically represented by personal interest in science. Results for the simple correlations (Table 5) indicate a statistically significant ($p<0.01$) correlation between the four TOSRA scales and the CLES scales of Personal Relevance, Uncertainty and Critical Voice. For the three TOSRA scales of Normality of Scientists, Attitude to Scientific Inquiry and Personal Interests in Science there were statistically significant ($p<0.01$) correlation with Shared Control and Student Negotiation. Results for multiple correlation (Table 5) indicate a statistically significant ($p<0.001$) correlation between each scale in the TOSRA and all scales in the CLES. Personal Interest in Science explains more portions of

correlation, excluding other ...e scales with the CLES. These results indicate that students attitudes to science are more likely to be positive in classes where students perceive greater personal relevance, uncertainty and critical voice.

Analysis of interviews and observations

In this section, the results from the quantitative survey were re-examined using data gathered during interviews and observations. To describe what the researcher observed in each class as vividly as possible, the field notes from each observation were re-constructed as a story soon after the observation. Those stories were compared with the result of survey and sometimes discrepancies were found between the survey and observation data. Reasons for these discrepancies were sought during interviews with teachers and students which found that: the sixth curriculum reflects only two notions of constructivism; Personal Relevance, Student Negotiation; students had interpreted item in the Critical Voice and Shared Control scales differently to the researchers' intentions; cultural and social characteristics could have influenced student responses to the CLES.

In this section, the differences and similarities between the quantitative data collected using survey and qualitative data gathered using interviews and observations are examined.

Personal Relevance

The survey data in this scale indicates that students perceived the connections between their science lessons and their daily experiences are 'sometimes' displayed in their classrooms. Interviews with students confirmed this result in three ways. First, textbook-dependent teaching practices in Korea might be one of the reasons why science-independent students showed more favourable perceptions on their science lessons. As science-gifted students learn 'general science', which focuses on everyday contexts, it is more likely that they find their science lessons to be more relevant to their everyday life. On the other hand, students in the other two streams are more likely to have lessons that are more academic or knowledge-oriented. Second, the impact of university entrance examination on practice could influence students' perceptions of this scale. Korean high school lessons are mainly driven by university entrance examinations and recent examinations have dealt with items related to everyday contexts. During observations, the researcher noted that teachers in the three streams often used examples from everyday contexts in their teaching. For example, one teacher remarked, 'O.K. you know, these examples were dealt with in the examination last year, and also make sure you understand the connection the concept we've learned today with the examples on page 113, all right?'. Third, students' interest in science could influence students' perceptions of this scale.

In general, students' responses as recorded on the CLES were reflected in interviews. Student responses implied that, usually, their science classes did not clearly deal with everyday experiences but if students were really concerned with issues, then it was possible to find links between science lessons and life experiences. As one student commented, "actually, I am interested in science, so I normally try to connect what I've learned in class to experiences in daily lives".

Science-independent stream students appeared to make the most personal effort to learn during science lessons. This stream has a relatively flexible curriculum and,

officially, students can use school facilities quite freely, which is not the case in the other two streams.

Despite tertiary entrance examinations including items that are related to everyday life and science teachers' recognition of the need to make science more meaningful to students (as recommended in KongTongKwaHak or 'integrated science'), the results of the national college entrance examination still appears to rule over what and how teachers teach in the senior high schools. Teachers still stress content in their lessons to ensure that students attain a high score in this examination, and often this means that they do not make lessons personally relevant to the student.

Uncertainty

In their responses to the CLES items, students expressed that they 'sometimes' learn about uncertainty of scientific knowledge. Observations and interviews with teachers indicated that these teachers' individual beliefs in the philosophy of science in addition to the formal curriculum could be the main reasons for their classroom practices. This was particularly evident in science independent stream, where students indicated that their classes provided them with examples of 'uncertain scientific knowledge'. In these classes teachers were more likely to display class materials, such as textbooks, written from guideline in curriculum.

It would appear that students' perceptions of this scale depend on the individual teacher's disposition towards teaching. In many cases it was found that, if the textbook did not indicate uncertainty then the teacher would not deal with this issue in their lessons unless they felt it important to do so. So, if such materials were not contained in the textbook guidelines, then despite teachers' eagerness to utilise a more constructivist approach, they may not include this aspect.

Critical voice

The results of the survey indicated that students were able to criticise the way in which they were taught. Interviews revealed, however, that these responses were related more to informal chats with other students than to the teacher. So, while students can complain or criticise how they are being taught, it is unlikely to have any effect on the actual teaching situation in their classrooms.

Interviews with students indicated that they were most reluctant to criticise their teachers and the way in which they are taught. The students' reluctance to criticise their teachers could reflect the Korean way of thinking. Traditionally, Korean students are expected to respect their teachers as elders, so they tend to be obedient, although there are some exceptions. Students whom were interviewed indicated that although they might have some complaints, they would not express them verbally or publicly. It was found that students were more likely to express these complaints to other students during conversations.

Interviews with students revealed that students' perceptions of the Critical Voice scale might be influenced by their economic status. Students from a higher economic status family appeared less likely to care about the way the teachers taught them, because they prefer to receive private lessons and tended not to value school lessons. On the other hand, students from lower economic status families were unlikely to criticise their teachers because the school is the only place for them to learn.

Shared control

The questionnaire data indicated that students generally had a less positive view of the Shared Control scale than other scales. However, students in science-independent streams tended to show more favourable responses in survey when compared to students in other streams.

Interviews with teachers indicated that students generally were not involved in planning lessons. As one teacher remarked. "You know, actually, our students are passive in the sense that they are not involved in pre-planning or evaluating. They receive what teachers provide. But at the individual level, especially high-achievers are relatively active in the management of their own learning". This view also was reflected in interviews with students in science-independent stream. During interviews with students in the humanity and science-oriented stream, however, it was revealed that their understandings for the items were far from the researchers' intended meaning.

When students were asked, "Do you get the chance to help your teacher to assess your learning?", one student responded, "Well, sometimes, the teacher asks us who is sitting in front row, to hand out and collect answer sheets when he gives tests. In this way, I think we help our teacher to assess our learning". While another stated, "Yes, we help the teacher to assess our learning by joining in peer-assessment. At the end of session, normally the teacher gives some quiz to us and each pair of us checks our partner's sheet, following the teacher's instruction".

Because of the highly examination-oriented reality for high schools in Korea, teachers are expected to provide factual knowledge that is considered correct by students and parents. Normally, parents judge the effectiveness of a school or teacher in terms of results and whether students enter into tertiary institutions. To achieve good results from tests, teachers are expected to stick to traditional, didactic, lecture-type teaching strategies, focusing on their own managerial ability. Because of this, classes are likely to be run with ready-set materials and planned by teachers. It is more likely, therefore, that students' participation in lessons, in terms of shared control, will be more related to helping teachers with tasks such as collecting papers and arranging materials. During interviews with science-independent students, they indicated that they could select some activities that had been suggested by their teachers. Even if choices were limited to the teachers' initiative, these students felt that they could participate in the class planning in this way.

In general, students that were interviewed had never been exposed to the kind of freedom expressed in the Shared Control scale of the CLES. In many cases, these students interpreted this freedom as a form of participation in the class.

Student Negotiation

Results of survey indicate that students perceived they frequently get involved in negotiation with their peers in their science lessons. Interviews with students also mentioned this trend, as one remarked, 'I can talk about problems with other students who are sitting near myself, sometimes we are required to make one report in a group". This is being encouraged by teachers, especially in practical lessons. Even in academic lessons, students prefer learning from their peers rather than going straight to their teachers. There are normally over 40 students in one class in high school class, so, practically it is quite hard for the teacher to interact with individual

student. Low-achievers, especially feel more comfortable with their higher achieving peers than with their teachers.

Discussion and Conclusion

This study explored the perceptions that Korean high school students hold about the constructivist nature of their classroom learning environment. Data was collected using three methods, survey, interviews and observations. The Constructivist Learning Environment Survey (CLES) was administered to 439 students, 145 students in four classes from the humanity stream, 195 students in four classes from the science-oriented stream and 99 students in five classes from science-independent stream. Analysis of the data confirmed the reliability and validity of a Korean version of the CLES for all scales. Overall this study replicated past studies using the CLES in Korea (Kim, Fisher and Fraser, 1999) and provides strong support for the reliability and validity of the CLES in Korea.

This study extended past learning environment research in Korean high schools. Previously, Kim et als (1999) investigated students perceptions in Korean high school. Her focus was on the effect of new curriculum and used only survey for data collection. This study included qualitative data and explored the perceptions of students in different streams, thereby extended the scope of learning environment study in Korea.

The results of survey data indicate that students in all three streams perceived constructivist approaches as being displayed 'sometimes' in their science classes. Of the five scales, assessed using the CLES, students' responses to the Shared Control scale showed distinctively lower mean score than any other scale. A comparison of the scale means between the three streams revealed that science-independent stream perceived their science classroom more favourably than did other two stream students for all scales of the CLES. These differences were explored in more depth using data collecting observations and interviews.

The mean scale scores for the Personal Relevance, Uncertainty and Student Negotiation scale indicated that students perceived them as occurring 'sometimes' and were confirmed with interviews. For the Shared Control scale, students interpreted individual items in ways that were consistent with the 'reality' in Korean classrooms and gave possible reasons for their responses to the survey. Student responses to the Critical Voice scale indicated that they could criticise their teachers' way of teaching, however, interviews revealed that they were only able to discuss their complaints within their peer groups.

During observations, the researcher noted that in classes in the science-independent stream, teachers appeared more receptive of students' talking and the lessons were mainly run using group activities and students' cooperation was natural and did not require without explicit/authoritative interception. Interviews also indicated that students from the science-independent stream were more likely to actively interact with their teachers than students from the other two streams. It was felt that this could be why students from the science-independent stream perceived more favourable classes. In this way, some aspects from quantitative data were confirmed with the results of qualitative inquiry.

Generally, students in Korean high schools perceived that the use of constructivist approaches was limited to personally relevant materials and active interaction between peers. For them, science classes were run mainly by teachers, using planned materials and without students' involvement. They appeared to accept this didactic way of teaching as effective and natural. Students seldom experienced

any control over their lessons, but felt that they were able to do some things for their teachers, in the form of simple assistance.

It would appear that the stream in which students study influences their attitude towards their science classes. A student's selection of stream is chosen according to a student's interests in science, which could influence their science-related attitudes. The results of the survey data indicate that science-independent stream students had the most positive perceptions of the learning environment, which is strongly associated with their interest in science.

As Cho et als (1997) pointed out, Korean science teachers have negative perceptions (feelings) towards the introduction of constructivist notions in their own classrooms, especially at the secondary high school level. This trend has continued to exist in teachers' mind-sets even since the national curriculum explicitly emphasised constructivist approaches. Despite the fact that negotiation and inquiry-based learning has, to some extent, been introduced to classrooms in Korea, the reality is that national College Entrance Examination still rules over the teaching practices across the subjects.

Deeper insights into students' responses to the CLES were gained through interviews and observations. Information gathered using these methods confirmed the findings, in some cases and modified the findings in others. It was found that when responding to items in the Critical Voice and Shared Control scale, mainly, students had interpreted them differently to the researchers' intention. In these cases, the students had either misunderstood the items or were confused between their individual thinking and what was actually happening in their classrooms.

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